In the United States Patent & Trademark Office

Application for Patent

FIBROUS-GLASS-FREE ACOUSTIC PANELS AND METHODS OF THEIR MANUFACTURE

Invented by:

Bruce Evans

Certificate of Express Mailing

I hereby certify that this paper or fee is being deposited with the United States Postal Service via "Express Mail Post Office to Addressee", addressed to Mail Stop Patent Application, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on this 15T day of NOVEMBER, 2003, pursuant to 37 C.F.R. 1.10, with an Express Mailing Label No. EU 230 905 500 US

Patrick Stellitano

[1000] This application claims priority of U.S. provisional application Serial No. 60/423,144.

Technical Field of the Invention

[1001] The present invention relates to the field of acoustic absorbing structures.

Background of the Invention

[1002] Acoustic enclosures are used to insulate sound generated inside the enclosure from the exterior environment, to insulate the interior of the enclosure from sound generated in the exterior environment, and to reduce reverberation of sound within the enclosure.

[1003] For example, many high schools and music schools provide sound isolation modules for music practice, enabling a plurality of music students, each one in a separate module, to simultaneously play his or her instrument without acoustical interference from music generated in another enclosure or from sound generated in an

environment exterior to the sound isolation module. In an industrial setting, machinery often generates large volumes of sound that interfere with human productivity within offices that need to be located at or near the sight of the machinery. In this case, an acoustic enclosure is often deemed essential, or at least highly desirable, to protect the office environment from the machinery noise. A radio broadcast booth is another familiar example where acoustic enclosures are instrumental in shielding from unwanted penetration of acoustic energy and reverberations. In some cases a wall or surface, less than an enclosure, provides acoustic absorption. For example portions of hallway walls may provide acoustic absorption to reduce acoustic reverberation.

[1003] An acoustic structure typically is formed of a plurality of panels, each panel comprising one or more acoustic absorbing materials enclosed by steel or other rigid structure. Typically, the acoustic absorbing material comprises fibrous glass products, including spun mineral and spun wool products that exhibit high absorption of acoustic energy. However, the fibrous glass content also may contribute to skin irritability and reduced air quality when very small glass fibers of the absorbing material escape from the structure enclosing it and enter the surrounding environment. Consequently, there is a need for acoustic absorbing panels that substantially reduce these problems. Another problem with existing materials is that they do not provide internal structural support to hold acoustic septums in place without the use of stiffening or fastening structures. Therefore, there is a need for acoustic fill materials that enable the installation of septums without additional structural mechanisms to hold them in place. For at least these reasons there is a need for the present invention, as described hereinafter.

Summary of the Invention

[1004] The present invention provides methods and apparatus for constructing an acoustic absorbing panel that overcomes limitations of the prior art.

[1005] According to an aspect of the present invention a method is provided for constructing an acoustic panel using an acoustic fill material that is substantially free of fibrous glass such as Ultra Touch Natural cotton fiber insulation. The chosen material is preferably of sufficient thickness to provide acoustic absorption comparable to the absorption provided from currently used fibrous glass materials.

[1006] According to another aspect of the invention, acoustic absorbing material of sufficient incompressibility is employed to support the installation of acoustic septums within the panel between two regions of the acoustic absorbing material without the need for additional structural support elements to hold the septums in place.

[1007] According to another aspect of the invention, an acoustically penetrable fibrous glass-free sealing membrane is applied to an interior surface of the panel enclosing the acoustic absorbing material. The sealing membrane substantially prevents particles of the acoustic fill material from escaping from the acoustic panel into the surrounding environment. The sealing membrane can also prevent dirt from lodging in the internal acoustic fill material.

[1008] According to another aspect of the present invention, the acoustically penetrable membrane is adhered to the inner surface of the panel during a process of applying a coating to the panel at an elevated temperature. An elevated temperature causes the membrane to partially melt onto the inner surface of the panel. When the panel cools to an ambient temperature, the membrane solidifies and adheres to the

inner surface of the panel. The membrane thereby acts to seal the porous surface of the panel while allowing a uniform appearance of the applied coating. Alternatively, the membrane may be adhered to the surface by heating without application of a coating to the panel, or by using a bonding agent applied between the membrane and the inner surface of the panel.

[1009] The foregoing has outlined rather broadly the features and technical advantages of the present invention in order that the detailed description of the invention that follows may be better understood. Additional features and advantages of the invention will be described hereinafter. It should be appreciated by those skilled in the art that the disclosure provided herein may be readily utilized as a basis for modifying or designing other structures for carrying out the same purposes of the present invention. Persons of skill in the art will realize that such equivalent constructions do not depart from the spirit and scope of the invention as set forth in the appended claims, and that not all objects attainable by the present invention need be attained in each and every embodiment that falls within the scope of the appended claims.

Brief Description of the Drawings

[1010] For a more complete understanding of the present invention, and the advantages thereof, reference is now made to the following descriptions taken in conjunction with the accompanying drawings, in which:

[1011] Figure 1 shows a cross-section of an embodiment of an acoustic panel according to the present invention.

[1012] Figure 2 shows a cross-section of another embodiment of the present invention.

Detailed Description of the Preferred Embodiments

[1013] Figure 1 shows a cross-section of an acoustic panel 1000 constructed according to the present invention, which preferably comprises sheets of steel 1100 and 1200 that are bent to form an enclosure around a fibrous-glass-free acoustic fill material 1400. The sheets 1100 and 1200 are preferably 22 gauge steel. Sheet 1100 is perforated to enable acoustic energy to enter into the interior of panel 1000 wherein the energy is at least partially absorbed by acoustic absorbing material 1400. Thus, sheet 1100 forms an acoustically penetrable partition between regions I and II. Sheet 1200 is typically not perforated so that sheet 1200 forms a substantially acoustically impenetrable partition between regions II and III.

[1014] Acoustic absorbing material 1400 is a material that is substantially free of fibrous glass, thereby reducing the potential for introducing fibrous-glass particles from entering the environment. Cotton fiber materials, such as shredded denim, are available that provide acoustic absorption without presenting undesirable fibrous glass that might otherwise escape into the surrounding environment. For example, acoustically suitable materials provided by Bonded Logic, consist almost entirely of natural denim and cotton fibers that are 100% recyclable, reducing landfill waste and conserving natural resources. For a given thickness, the acoustic absorption provided by these materials is comparable to existing fibrous-glass materials currently in use. Other fiber-free materials that may be employed according to the present invention include melamine, cellulose, and spun textile products.

[1015] Between the inner surface of sheet 1100 and acoustic material 1400 is a membrane 1600. This membrane is acoustically penetrable, allowing acoustic energy to penetrate through the membrane to be absorbed by acoustic absorbing material 1400. Membrane 1600 acts to substantially prevent fibers from acoustic absorbing material 1400 from escaping into a surrounding environment, while allowing acoustic energy to penetrate into acoustic absorbing material 1400 through the perforations in sheet 1100.

[1016] A colored coating is often applied to the exterior of sheet 1100 in applications where an acoustic panel is desired to exhibit an appearance of uniform aesthetically pleasing color. In such applications the coating may be applied by dry spraying a powder coating in a paint booth and running the panel through a bake oven. Heating sheet 1100 causes the coating to adhere to the exterior of sheet 1100. A typical temperature range for this heating process is 350 to 450 degrees Fahrenheit. In this case, membrane 1600 is preferably a material that will melt or become amorphous in a temperature range at which the coating is applied to the exterior surface of sheet 1100.

[1017] After the coating is baked on, sheet 1100 is allowed to cool to an ambient temperature. The material for membrane 1600 is therefore also chosen so that membrane 1600 will solidify and adhere to the interior surface of sheet 1100 when sheet 1100 cools to an ambient temperature. A suitable material for membrane 1600 is an HL-4 media made of 100% non-woven polyester fibers; a product of Glasfloss Industries, which is available in a variety of thicknesses. Other suitable non-woven acoustically penetrable textile products may be employed also.

[1018] An important advantage of the application of membrane 1600 in the dry powd r coating application process is the ability to achieve a uniform aesthetically

pleasing finished appearance. Without the application of the membrane some of the powder apparently penetrates the perforations of sheet 1100 so that when the process is completed a marbled non-uniform appearance results. Application of the membrane between acoustic material 1400 and sheet 1000 prior to exposure to the powder apparently prevents the powder from penetrating the perforations, so that upon completion of the coating process a substantially uniform coating without an undesirable marbling effect is achieved.

[1019] Alternatively, membrane 1600 may be adhered to the interior surface of sheet 1100 by heating sheet 1100 without applying a powder coating to sheet 1100, as would be readily apparent to one of ordinary skill in the art given the disclosure herein. Thus, when the membrane is to be adhered to a surface of sheet 1100 by applying an elevation of temperature, the object is not necessarily to heat sheet 1100. Rather, the object can be to heat membrane 1600, with any heating of sheet 1100 being incidental thereto.

[1020] As another alternative, the membrane may be adhered to the inner surface of sheet 1100 using an adhesive bonding agent. This may be preferable when traditional wet-paint coatings are applied to sheet 1100 without the application of heat.

[1021] A further advantage to the use of membrane 1600 is its ability to substantially prevent dirt or other contaminants from entering through the perforations of sheet 1100 into the acoustic material 1400, thereby resisting damage to the physical and acoustic integrity of the acoustic material within panel 1000.

[1022] Note further, that the membrane material may also be applied between sheet 1200 and acoustic absorbing material 1400, according to one of the processes

described above. In addition the membrane material may be applied between acoustic absorbing material 1400 and sides 1010 and 1020 and ends (not shown), which sides and ends may be formed by bending edges of sheets 1100 and 1200. Thus, membrane 1600 may be extended to entirely enclose acoustic absorbing material 1400. Alternatively, the membrane material may be applied by wrapping the acoustic absorbing material 1400 with the membrane material.

[1023] The present invention also provides for the use of acoustic absorbing materials that exhibit a degree of incompressibility greater than typical fibrous-glass materials so that support is provided for installation of septums. Referring to Figure 2, a first acoustically penetrable partition 2100 allows acoustic energy from a first region I to penetrate into an interior region II of an acoustic absorbing structure 2000. Within region II is an acoustic absorbing material 2400 that is preferably substantially free of fibrous glass. A second partition 2150, preferably made of 11, 14 or 18 gauge stainless steel, is provided between region II and a third region III. Within region III is an acoustic absorbing material 2500 that is also preferably substantially free of fibrous glass. A third partition 2200 that is acoustically penetrable is provided between region III and a fourth region IV.

[1024] The materials chosen for acoustic absorbing materials 2400 and 2500 are chosen to provide sufficient support to substantially prevent lateral movement of partition 2150 between partitions 2100 and 2200 without any additional structure required to prevent such movement. The cotton fiber material identified above is adequate for this purpose. Preferably, partition 2150 is substantially acoustically impenetrable, thereby forming an acoustic isolation septum between regions II and III.

Thus, the configuration of Figure 2 may be employed to prevent sound from region I from entering region IV and vice versa. Additionally, membranes 2600, or either of them, may be applied as described above.

[1025] Although the present invention and its advantages have been described in detail, it should be understood that various changes, substitutions and alterations can be made herein without departing from the spirit and scope of the invention as defined by the appended claims. The invention achieves multiple objectives and because the invention can be used in different applications for different purposes, not every embodiment falling within the scope of the attached claims will achieve every objective. Moreover, the scope of the present application is not intended to be limited to the particular embodiments of the process, machine, manufacture, composition of matter; means, methods and steps described in the specification. As one of ordinary skill in the art will readily appreciate from the disclosure of the present invention, processes, machines, manufacture, compositions of matter, means, methods, or steps, presently existing or later to be developed that perform substantially the same function or achieve substantially the same result as the corresponding embodiments described herein may be utilized according to the present invention. Accordingly, the appended claims are intended to include within their scope such processes, machines, manufacture, compositions of matter, means, methods, or steps.

[1026] What is claimed is: